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AVOCADO ESTABLISHMENT AND PRODUCTION COSTS AND PROFITABILITY ANALYSIS IN HIGH DENSITY PLANTING

Picture source: Bender, summer 2014 / From the Grove / 37

SAN DIEGO COUNTY

HASS VARIETY

AVOCADO ESTABLISHMENT AND PRODUCTION COSTS AND PROFITABILITY ANALYSIS IN HIGH DENSITY PLANTING

SAN DIEGO COUNTY, 2020

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ABSTRACT

We developed this study for growers, prospective growers, agricultural lenders, and all who are involved or have interest with the establishment and production practices of high density planting of avocado orchards in San Diego County. We present estimates of the financial requirements for establishment and producing avocados for high density planting of 10'x10'; 430 trees per acre, and analyzing the enterprise profitability in San Diego County. The high density planting is almost 3 times of the traditional planting of 20'x15'=145 trees per acre. The data for this study is partially from a field experiment conducted by Farm Advisor Dr. Gary Bender at a commercial farm with a cooperating grower in Valley Center, California from 2011-2018. The data measured in the experiment included yield, irrigation water use and pruning methods. Data for all other cultural practices were obtained from interviewing the

cooperating grower in 2018 as well as referencing the conventional production practices from the study we conducted in San Diego County in 2011 We provide establishment cost estimates; cumulative for years 1 through 6, and annual production costs and profitability analyses for the high density planting. Our estimate of establishment cost is $17,597 per acre and production cost is at $16,233 per acre. Given the average yield of the experiment of 16,220 lbs. per acre (average of 4 years from 2014 to -2017) and an average price of $ 1.32 per lb., returns to management is estimated at $6,260 per acre.

INTRODUCTION

Avocado has been one of the prominent crops produced in southern California since the early 1950s. California avocado production reached peak in 1987/88 with about 76,307 acres. San Diego had been the leading producer accounting for about 60% of the acreage. However, there has been a continuous decline of acreage and production of the crop in this county, beginning in the early 1980s. Even in the last decade, acreage declined by 28% from 24,684 in 2009 to 17,741 in 2018 in San Diego County. This is mainly because of the expansion of urban development that has increased the cost of producing the crop and especially the cost of water reaching to up to $2,000 per acre feet in 2020. With urban development also came environmental regulations and the need for growers to introduce management strategies to meet regulatory standards, therefore adding to the increase in the investment and production costs. Decline of acreage also happened in the neighboring County of Riverside. In addition, global production increase and the growth in the supply of avocados more than its demand caused price declines and grower returns in the US and in California. The University of California Cooperative Extension (UCCE) specialists and advisors for years have conducted experiments and field trials to develop management strategies including irrigation, nutrition and pruning for improving productivity and seeking cost effective practices to increase sustainability of producing avocados in the region. We did explore the potential of organic production including development of cost of production and profitability analyses (Takele, et. al 2011).

In 2011, Dr. Gary Bender, Farm Advisor, now emeritus in San Diego County initiated a field trial/experiment in Valley Center, California to study the productivity, water consumption and punning strategies of high density planting. The experiment was conducted at a cooperating grower's field from 2012-2017 with planting space of 10'x10'; 430 trees per acre. In 2018, Etaferahu Takele conducted a partial budgeting economic analysis to evaluate the results of the experiment. The partial budgeting analysis showed that high density planting increased returns. It also showed that the high density water consumption to be cost effective. This is because the same amount of water was sufficient for the high density as it was for the traditional planting (20'x15'=145 trees per acre.). However, in order to get a full picture of profitability, we conducted a full enterprise budget analyses of a high density planting including estimates of establishment costs (investment requirement) and production costs and returns.

The use of trade names and cultural practices in this report do not constitute an endorsement or recommendation by the University of California, nor is any criticism implied of other products or cultural practices that are not discussed in this cost study. *The University is an affirmative action/equal opportunity employer.*

ASSUMPTIONS

This study includes production practices; inputs, application rates, time of application, and methods of production of high density avocado production in San Diego County, California. Input prices, contract and service fees are based on 2019-2020 prices.

Orchard Specifications: The land is open virgin land, never been in agriculture before, but had bushes and trees. It is on a hillside with a gentle slope and did not have a history of avocado root rot. The soil is clay loam with a large amount of granite rocks. The land has roads already set up.

For the purpose of estimating and distributing machinery costs, and property and liability insurances costs, we assumed the farm size to be 21 acres where 20 of the 21 acres will be in actual production and 1 acre will be in roads, pathways and farmstead. This is the typical size of avocado orchard in San Diego County.

ESTABLISHMENT AND PRODUCTION PRACTICES

Land preparation: The grower described the land preparation for the high density avocado orchard planting as follows.

1. Crushed all the brush to create a stable surface of organic residue and to maintain erosion control. The brush was crushed with multiple hand tools (shovels, axes, etc.). Any brush that was too big to be crushed was removed from the site by a pick-up truck. This job per acre took 2 days with eight workers each working 8 hours.
2. Digging tree roots out was a strenuous job especially as it was a clay soil. It took about 3 hours per acre. When encountering clay which was a thicker and harder, a drill was used in order to dig through it.
3. Orchard layout included installation of irrigation and drainage systems, and grading for erosion control and planting spaces design. Irrigation system installation involved placing valves, water meters, and main lines going down the hill. The main line and side lines, splitters and micro sprinklers were installed before planting. The following year, Watermark soil irrigation monitors were installed at the edge of the root balls, 8" below the soil surface. These were hard-wired to a battery-powered box for monitoring. Watermarks were located at the top of the plot, mid-plot and in the bottom row of the plot. The soil had a large clay content, therefore the trees had to be irrigated when the watermarks averaged 35 40 cb (cb is the soil moisture tension sensor reading). It seemed to work perfectly and the trees never had any tip-burn from dryness or salinity. The irrigation system including installation cost approximated at $2,600 per acre.
4. Erosion control methods also included seeding the exposed areas of the ground done twice a year once in December and once in January in addition to grading for erosion, irrigation drainage system and paving the roads as mentioned above. Erosion control is done throughout the life of the orchard and includes cleaning drains and sand bagging (as was also mentioned in the 2011 study, Takele, et. al). These operations take about 3 hours per acre per year.

Planting: Planting operations included the following;

1. First digging up holes using drills and shovels, followed by; transporting the trees from the nursery to the grove for planting.
2. The top soil was then mixed with gypsum and placed into the backfill. In each hole a couple of shovels full of gypsum, approximately 7 pounds per hole is applied. Gypsum ($0.012 per pound) was applied to suppress development of root rot.
3. A layer of mulch in the tree rows was applied as groundcover in order to help reduce water evaporation, erosion and for containing/suppressing weeds. Mulch also suppresses the development of root rot and reduces the adverse effects of saline soil and water (IPM, 2011). Orchard Mulch 2-inch sized was applied in the first and third year.at 40 cubic yards per acre at a price of $5 per cubic yard.
4. Trees spaced 10'x10' or 430 trees per acre were planted in September of 2012 at a cooperating grower's field in Valley Center, California. The planting included 1 Zutano pollinizer tree planted for every 8 Hass trees. All of the trees were grafted onto clonal Dusa rootstocks. The Dusa rootstock is currently the most tolerant rootstock to avocado root rot disease. The cost $32 per tree applies for both the Hass and Zutano.

5. Avocados that come from the nurseries normally come without central leaders which makes it difficult to form a true pyramid shape. Therefore, sterilized metal stakes are tied with each plant from the top branch to the stake in order to make a quasi-central leader. Stakes (2x2x6 ft) cost $2.20 per unit based on bulk purchase price. Digging, planting, and staking the trees are estimated to take 107.50 hours per acre (15 minutes per tree).
   During this experiment, there was a heat wave during the planting period so 10 trees were lost, but those trees were immediately replanted

Pruning: In high density planting, pruning is a huge consideration to keep the trees from crowding How to prune and when is often a heavily debated topic because of the fact that there are always young fruits, maturing fruits, and/or flowers on the trees. The traditional method of pruning high density trees is to prune all the sides and top yearly. In this trial, two styles/methods of pruning were done and evaluated for production differences.

1. Style 1: Pruning was done right after harvest in March and trees pruned in a similar shape to a fat Christmas tree, topping the tree at 7'. The objective was to keep the tree's height in the 8' range in order to achieve the ideal height at 80% of the tree's (10'x 10') spacing. Trees also were skirt-pruned at the same time keeping the skirts one foot off the ground. Pruning began in 2014.
2. Style 2: Pruning was done right after harvest in March (same timing as style 1), however, it involves alternate-side pruning starting with the south-west side first. The side that was pruned was heavily pruned creating a 60-degree angle from the lowest branch on the pruned side to seven-foot height on the tree. The non-pruned side was left alone in order to preserve as much fruiting wood as possible. The following year the north-east side was pruned heavily, and back to the south-west side the following year. Trees were skirt pruned at the same time to one foot off the ground. Pruning began in 2014.
3. Clearing the aisles was part of the pruning process. In the fourth year of the establishment, it was necessary to begin clearing the aisles in order to allow enough room for workers to walk around the trees and to allow sunlight reach the lower branches. Also, in order to clear the aisles, branches were cut back or removed that were growing into the neighboring trees. Clearing the aisles was done each year in late July and late September. Clearing the aisles is estimated to take 8 hours per acre each time.

Comparing the two styles of pruning, the results showed no significant differences in yield, (Bender, 2018) clearly indicating that pruning style 2 (alternate pruning) takes less hours than whole tree pruning and has therefore proved to be cost effective. We used style 2 or alternate pruning in this study. Table 1 shows the hours of pruning by age of tree.

Table A. Hours of Pruning; Valley Center Field Trial, Using Alternate Side Pruning, 2012-2017.

	Trees in the Trial			Per Tree		Trees per Acre		
	Zutano	Hass	Hass/Zutano	Zutano	Hass	Zutano	Hass	Total
	9	72	81	1 per Tree		54	376	430
2012 (Planted)	-	-	-	-	-	-	-	-
2013	0.75	0.75	-	-	-	-	-	-
2014	1.00	4.00	5.00	0.11	0.06	6.00	20.89	26.89
2015	2.00	6.00	8.00	0.22	0.08	12.00	31.33	43.33
2016	2.00	8.25	10.25	0.22	0.11	12.00	43.08	55.08
2017	2.00	7.00	9.00	0.22	0.10	12.00	36.56	48.56

IRRIGATION

Watering was done by the grower with guidance of the Principal Investigator Dr. Gary Bender and his staff research associate, but there were some mistakes of water use as the water was left running overnight in 2016. The water use was corrected in 2017 and is the approximate water use we used in production years (mature trees). Table 2 provides the irrigation water application by year *(*Bender, 2018*)*.

The price of water varies depending on the source (wells or district water), method, and pumping distances to the orchard. It also depends on pumping capacity, pump size, and elevation. In San Diego County much of the water source is district water. For this study, water is bought from the district at a charge of $1,900 per acre-foot ($158.33 per acre-inch).

Table B. Irrigation Water Application Per Acre per Year, Valley Center Field Trial, 2013 - 2017.

Time Period	Gallons	Acre Feet	Acre Inches
2/15/2013-10/31/2013	381,926	1.17	14.04
11/1/2013-10/31/2014	1,075,615	3.30	39.60
11/1/2014-10/31/2015	938,595	2.88	34.56
11/1/2015-10/31/2016	1,571,336	4.82	57.84
11/1/2016-10/31/2017	1,234,293	3.79	45.48

Frequency and amount of irrigation water use depended on weather, rainfall, and location. The grower irrigated from March through November (9 months). Irrigation schedules included once a week during the spring and fall months but twice per week during the summer months (Table 3). Irrigation labor accounts for time of the irrigators walking through the orchard to inspect the system, water flow, fixing leaky problems, or cleaning emitter clogs caused by rodents, insects, and chemical precipitations. Each time the irrigators had to perform their duties, it took them 15 minutes/per irrigation/per acre.

Table C. Number of Irrigation Applications by Month, Valley Center Field Trial, 2013 – 2017.

Winter and Spring Months	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Frequency	1x per week			2x per week			1x per week			
Times/Month	4.30	4.30	4.30	8.68	8.68	8.68	4.34	4.34	4.34	52.08

PEST MANAGEMENT

Pest management practices remain the same as our 2011 study. There are different varieties of pests found in California avocado orchards. Some common types of pests include loopers, moths, thrips, persea mites, gophers, and ground squirrels. In California, avocado orchards are under good biological control due to beneficial insects that prey on parasitize harmful pests like the omnivorous loopers and amorbia moth. Thrips and persea mite control methods include application of insecticides such as Abamectin (Agri-Mek) mixed with 1% narrow range 415 oil (NR415) once per year in April beginning in establishment year 3 when trees reach bearing age. Abamectin application includes 15 ounces ($1 per ounce) and NR415 oil 1 gallon of ($10 per gallon per acre). Application is usually by aerial application ($145 per acre by helicopter). Growers in most cases utilize the consultation and contract of a Pest Control Advisor (PCA) for monitoring pest population in the orchard and release of beneficial insects as needed. The PCA charge is estimated at $38 per acre per year starting from the third year of establishment.

Rodents (gopher and ground squirrels): These pests cause problems in avocado orchards. According to UC Integrated Pest Management program experts, gopher control is needed to prevent damage to young trees. Gophers gnawing can damage sprinklers, and their tunnels can divert and carry off irrigation water. Gopher control is particularly needed during the first three years of establishment. Two gopher traps per acre are needed and set up during the first year of establishment after planting. Each trap costs $7.50 per unit. The costs of traps are spread over the first three years of establishment ($5 per acre per year); however, the traps can last up to ten years. Labor hours to check traps and collect dead gophers are estimated at 2 hours per acre per year (10 minutes per acre per month).

In addition, squirrel control is needed throughout the life of avocado trees or until squirrels are under control. Traps and anticoagulant bait are used for squirrel control in order to prevent tunneling through soil and erosion problems. Traps are set during the first year of establishment; one squirrel trap ($20 per trap) is set between two acres ($10 per acre) and lasts up to ten years before replacement. Therefore, the costs of the traps are spread over ten years at $1 per acre per year. Also, one bait station serves one acre. Each bait station costs $2.30 and can last up to 10 years; therefore, the cost per acre per year for the bait station becomes $0.23. Anticoagulant bait is applied monthly throughout the year. Total bait application was 2.64 pounds per acre per year (0.22 pound per application per month) and cost $3 per pound. It takes about 1.5 hours per acre per year (7.5 minutes per acre per month) to set trap, lay out bait station with bait, replenish bait, and collect dead squirrels during the first year of establishment. From the second year onward, it also takes 1.5 hours per acre per year (7.5 minutes per acre per month) to collect dead squirrels. Dead squirrels may also be collected throughout the year during other operations such as pruning, irrigation, and weed control.

There may be other pests present in avocado orchards in the study areas; therefore, growers must adjust their costs of pest management as applicable. For more information on pesticide use permits, growers may contact their County Agricultural Commissioner's office or Cooperative Extension farm advisors. The University of California also has pest management information on the UC Statewide Integrated Pest Management Program website at: http://www.ipm.ucdavis.edu/PMG/selectnewpest.avocado.html.

Coyotes are other problems in avocado orchards. Baby coyotes tend to nibble on trees and damage irrigation systems especially irrigation line pipes.

Weed Management: The weed management practice commonly used in the area for conventional avocado production corresponds to our previous sample cost study we developed in 2011. Weeds can harbor insects and pests, making it difficult for rodent control. Also, too much weed interferes with efficient application of irrigation water to the avocado trees. The two typical weed management practices include herbicide applications and weed whipping. Herbicide is sprayed three times per year during February, May, and August. Each herbicide application consists of about 10 ounces of generic glyphosate and water mixture per acre. Generic glyphosate costs $0.11 per ounce based on bulk purchase price. We estimated about 4.5 hours (1.50 hours per application) for 3 herbicide applications per acre per year.

Additionally, hand weeding and weed cutting require 1 hour per year during the first year. Thereafter, hours reduce to 50 minutes per acre per year. Weed cutting is estimated to take 2 hours per acre per year during establishment years 1 through 5; done once per year in March using a weed whip. Weed management will most likely reduce as trees grow bigger because the canopy shade will reduce weed growth. Weed whipping will continue throughout the production years at 1 hour per acre per year.

Fertilization: This study assumed the same amount of fertilizer application per tree as was used in the conventional avocado production cost study (Takele, et al, 2011). Per our discussion with the grower, the fertilization process takes

place every other month on a 9-month application program from February through October. Calcium ammonium nitrate (CAN-17%) is the most commonly used compound source for Nitrogen (N) for avocado fertilization in San Diego and Riverside counties. CAN-17% costs ~$1.00 per gallon based on bulk purchase price in 2019. Table 4 presents the amount of N by age of trees and the amount of CAN-17% needed to provide the N. Fertilizer is commonly applied through the irrigation system.

In addition, zinc sulfate 12% is applied once every five years if leaf analysis determines zinc deficiency. For this study, five gallon of zinc sulfate 12% is applied once in May during the 5th year of establishment through the irrigation system. Zinc sulfate 12% cost $4.60 per gallon based on bulk purchase price. In order to reflect the annual cost of zinc sulfate application, the cost is distributed over five years (1 gallon per acre @ $4.60 per gallon per year).

Table D. Nitrogen (N) Fertilizer Application Per Tree and Per Acre by age of tree.

Year	Lbs./Tree/Yr. N	Lbs./Acre/Yr. N	Gal/Acre N	Gal/Acre CAN-17
1	0.15	64.50	5.86	34.49
2	0.30	129.00	11.73	68.98
3	0.45	193.50	17.59	103.48
4	0.60	258.00	23.45	137.97
5	0.75	322.50	29.32	172.46
6	0.90	387.00	35.18	206.95
7	1.05	451.50	41.05	241.44

- *1 gallon of CAN-17% weighs ~12.64 lbs. and contain ~2.15 lbs. of N.*
- *Pounds of N per acre per year is calculated by taking pounds of CAN-17% per acre per year multiplied by 17%.*

Liquid fertilizer such as 15-5-5 if applied would make up 15% of N application. It also provides 5% Phosphate, and 5% Soluble Potash. We assumed application of 15-5-5 every other month (about 4-5 times per year) during the growing months of March through October at approximately 6 quarts per acre each time.

Root Rot Treatment: Potassium phosphite is applied for root rot treatment at the rate of 2 gallons per acre applied through the irrigation system two times per year in May (1 gallon) and September (1 gallon). Potassium phosphite costs $33 per gallon.

Interest on Operating Capital: Interest on operating capital is calculated at an annual short term/ operating loan rate of 5.25% charged by Production Credit Association in 2019-20. The interest on operating capital reflects borrowing costs for short term loans and/or opportunity costs for using own money. An opportunity cost is the return forgone by choosing to produce avocados instead of using the money on other alternative investment options.

Labor: Labor wages (including payroll overhead/benefits of 48.33%) of $26.70 per hour for equipment operators and $19.28 for manual labor. The basic hourly wages are $18.00 for equipment operators and $13.00 for manual labor. The overhead includes the employers' share of federal and California state payroll taxes, workers' compensation insurance for orchard/fruit crops (code 0016), and a percentage for other possible benefits. Workers' compensation costs will vary among growers. These costs are based upon the Occupational Employment Statistics (OES) survey results, January-2020.

HARVESTING AND MARKETING

Yield: Fruit bearing in the high density trial began in the third year of establishment Bender.

Table E. Yield per Acre from a High Density Planting Valley Center Field Trial

Year	Trial Year	Yield (Lbs.)/Acre
2012	Planting	-
2013	Year 1	-
2014	Year 2	-
2015	Year 3	13,246
2016	Year 4	25,100
2017	Year 5	5,541
2018	Year 6	20,992
Average of 4-6 years		16,220

The 2017's harvest was an off-year because of high temperature in June 2016 and typical alternate bearing.

Growers in San Diego and Riverside counties typically harvest from January to August depending on weather and production level. Harvesting costs includes picking, hauling, and the California Avocado Commission assessment (CAC) fee. Picking fees based on the information from the cooperating grower is estimated at $0.09 per pound. There was no difference of harvest rates assumed between establishment and mature trees as trees are always pruned to 8' feet high for easy reach. Also, the slope of the grove is not as steep as some of the groves in San Diego County. Hauling fees to the nearest packing house or cooling house is estimated at $0.004 per pound. The CAC assessment fee is estimated at 1% of the total crop value.

Hass Avocado Board Assessment (HAB) Fee: There are also fees to first handlers who belong to the HAB; a 2.5 cent per pound assessment fee, which will be remitted to the HAB. According to 7 U.S.C. 7801-7813, first handler is defined as a Hass avocado marketing operator that sells domestic or imported Hass avocados for United States domestic consumption, and who is responsible for remitting assessment to the HAB (2000). However, we do not have sufficient information whether all Hass avocado growers belong to HAB and whether or not they pay the HAB assessment fee. Therefore, we did not include HAB fees in this study. For more information on HAB, growers can check with their packinghouse (first handler).

Price: We used the San Diego agricultural crop report prices for Hass Avocados to estimate income from production during the experiment years (2014-2017). Prices vary from year to year. Thereafter we used the average price of the four years for estimating future income for production years.

CASH OVERHEAD

Office Expenses: In many cases, growers do not keep a separate record for office expenses such as supplies, telephone services, faxes, photocopies, computers, bookkeeping, accounting, legal fees, and so on. These expenses are handled along with home or other business expenses. For the purpose of identifying enterprise profitability, we suggest that growers keep records of these expenses separately by enterprise. In this study, based on discussion with local growers of avocados, we estimated office expenses for the enterprise at $150 per acre per year.

Property Taxes: San Diego and Riverside counties charge a base property tax rate of 1% on the assessed value of assets, including land, equipment, buildings, and improvements. Special assessment districts may charge additional property taxes but for this study we calculated county taxes at the base rate of 1%.

Property and liability Insurance: Property and liability insurances for the farm size of 20 acres in our study include $8.86 per $1,000 asset value for property insurance and $546 per orchard ($26 per acre for 21 acres) per year for liability insurance.

Investment Repairs: Investment repairs and maintenances are calculated at 2% of tool and irrigation investment.

Interest on Establishment or long-term interest rate: Capital recovery are calculated using 5.50%, California's long-term rate of return on agricultural production assets from current income.

Other expenses: Other overhead expenses include leaf analysis, soil analysis, and sanitation fees.

- Leaf analysis is done using a sample of about 40 leaves picked from different trees throughout the orchard and is typically conducted in September. It costs about $55 for the first 10 acres and an additional $20 for another 10 acres ($7.50 per acre for the 20-25 acres orchard).
- Soil analysis is also conducted in September; it costs $70 for the first 10 acres and an additional $25 for another 15 acres ($8.66 per acre for the 20-25 acres orchard).
- We did not include sanitation fees in this study because the need for sanitation facility is during harvesting which is provided by harvesting contractors. Growers rarely rent sanitation facility during the remaining parts of the production year.
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Equipment Overhead Costs: Equipment complement: The equipment complement includes pick-up truck for material deliveries and for trips to the market for supplies; and an ATV for movement within the grove including for checking and monitoring the irrigation system, erosion control, and rodent control. For this study, we assumed a pick-up truck is used for 7.5 hours per acre per year and the ATV is used for 15 hours per acre per year.

Equipment operating costs: including fuel, lubrication, and repairs are calculated using formulas and coefficients developed by the American Society of Agricultural and Biological Engineers (ASABE). Repair costs are based on purchase price, annual hours use, total hours of life, and repair coefficients formulated by ASABE. Fuel and lubrication costs are based on machinery horsepower (maximum PTO-HP) and the type of fuel used. We used fuel prices of $3.20 per gallon for gasoline and $2.92 per gallon for diesel, obtained from the U.S. Energy Information Administration.

NON-CASH OVERHEAD

Land Rent: Market prices for land usually show not only the production value of land but also the speculative value of land, which include its uses for non-agricultural purposes. We used the values published by the California Chapter of the American Society of Farm Managers and Rural Appraisers annual publications on land values and leases. The land values published for avocados in San Diego and Riverside counties ranged from $13,300 to $35,000 per acre (the California Chapter of the American Society of Farm Managers and Rural Appraisers). We used the average value of $24,000 to estimate the opportunity costs (the returns foregone from not investing in other alternatives) of land at 5.5%, the California's long-term rate of return on agricultural production assets from current income.

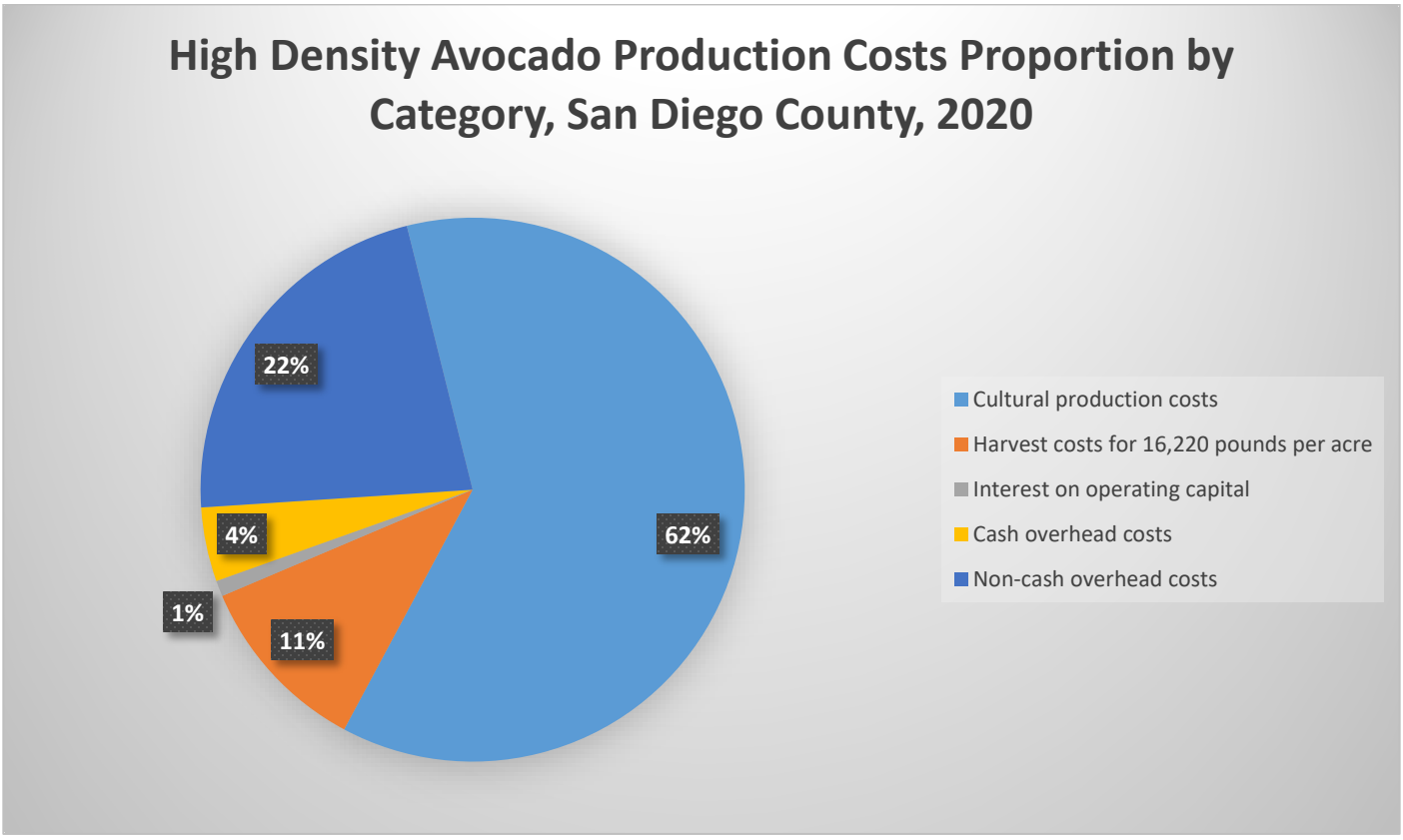
Ownership Costs (capital recovery or depreciation and interest on capital assets of Farm Equipment and Investments): We used the capital recovery method to calculate ownership cost of farm equipment and investments. This method allows growers to calculate an annual amount of money to charge the enterprise so that the value of assets will be recovered within a specific period at the designated interest rate. The interest used to calculate ownership cost is 5.50%, the California's long-term rate of return on agricultural production assets from current

income. We valued the equipment complement at a 60% of new prices to reflect a mix of old and new equipment complement.

Amortized Establishment Cost: The cumulative establishment costs (accumulated costs of establishment less the gross income for years 1-6) is the establishment cost. The establishment cost is then amortized at the long-term average rate of return on agricultural production asset from current income (5.50%) over a 34-year productive life to determine the annual amount that must be recovered from the investment.

Table Values: Due to rounding, the totals may be slightly different from the sum of the components.

Summary of Costs and Returns: The total establishment cost estimate (cumulative of the first 6 years costs and returns) for high density avocado planting of 10' x 10" (430 trees per acre) is $17,597 per acre (Table 1). The establishment cost amortized over the life of the grove is $1,955 per acre and is included in the annual cost of production to reflect the replacement cost of the investment. The annual production cost estimate is $ 16,233 per acre (presented in tables 3 and 4). Table 3 shows costs by type of activity and table 4 shows costs by type of input. The pie graph below shows the proportion of costs by category. Though water cost accounts for a major part of the total production cost (44% of the total production cost), in the high density planting, the water cost is proportionally less than the conventional planting when distributed over a higher yield per acre.



Profitability Analysis:

1. Gross margin: Gross margin (or returns above cash costs) is what growers often refer to as profit if there is no debt on the farming operation. It approximates the returns to management and investment. If you deduct depreciation, it also approximates taxable income. Gross margin is calculated as gross returns (price times

yield) minus cash costs of production. Based on our estimate, the enterprise shows a gross margin of $9,857 per acre.

2. Economic profit (or returns above total cost) is a very useful measure of how attractive the enterprise is for potential investors and entrants into the business. Economic profit can be positive or zero. A zero economic profit should not be alarming if all costs, including the owners' labor and management fees are included in the production cost. The estimate for returns to management for our data is $6,260 per acre. This shows that the high density planting provides a good prospect for profitability if production areas will be suitable for high density planting. The questions is given that most of the avocado production is on the hill side, would they be suitable for high density planting?

3. Break-even and Range Analyses: Applying the four year average yield of the experiment in the production years of 16,220 lbs. per acre, the break-even price needed for gross margin is $0.78 per lb. The break-even for total production costs is $ 1.00 per lb. Given the average price of $1.39 per pound, the enterprise shows gross margin of $0.61 per pound and returns to management of $0.39 per pound. In order to accommodate yield and price variations that may exist in the County, we provided a range analyses of gross margin and returns to management at various yield and price combinations (table 6). Growers can identify their gross margin and returns to management based on their yield and prices received.

References:

Spann, Tim. The Economics of High-Density Avocado Groves 2020 / From the Grove / 35, summer

Bender, G. 2018. High Density Avocado Production a Method to Improve Yield per Acre, BetterGrowing Winter 2018 / From theGrove / 39

Rolshausen, P., Mary Lu Arpaia, Mary, and Ben Faber, 2016. High Density Planting for Avocado Production: A Chilean Perspective, Better Growing, Fall / From the Grove / 1.

Bender, Gary. High Density Avocado Installation: Use a quick cost study to make a decision. 2013. TOPICS IN SUBTROPICS, A collaborative blog by UC farm advisors and specialists in subtropical horticulture in California. Sept.

Takele, E, Gary Bender, Mao Vue, 2011. Avocado Sample Establishment and Production Costs and Profitability Analysis for San Diego and Riverside Counties, University of California Cooperative Extension, https://ucanr.edu/sites/Farm_Management/files/156255.pdf https://coststudies.ucdavis.edu/en/archived/commodity/avocados/es/156255.pdf and https://coststudyfiles.ucdavis.edu/uploads/cs_public/5a/87/5a87bb11-59b3-4056-a2d6-a6e14507dd84/avocadoconventionalsdr2011.pdf

Takele, E, Gary Bender, Mao Vue, 2011. Avocado Sample Establishment and Production Costs and Profitability Analysis for San Diego and Riverside Counties, University of California Cooperative Extension. https://coststudyfiles.ucdavis.edu/uploads/cs_public/53/39/5339d98f-f575-4eab-8482-b3162d71a8fd/avocadosdrorganic_reports2011.pdf and https://ucanr.edu/sites/Farm_Management/files/156257.pdf

American Society of Agricultural and Biological Engineers. (ASABE). July 2015. *"American Society of Agricultural and Biological Engineers Standards Yearbook"*. Russell H. Hahn and Evelyn E. Rosentreter (ed.). St. Joseph, MO. 41st edition, ANSI/ASABE S279_17.PDF. hq@asabe.org

Boehlje, Michael D., and Vernon R. Eidman. 1984. *"Farm Management"*. John Wiley and Sons. New York, New York.

California Chapter of the American Society of Farm Managers and Rural Appraisers. 2020 *"Trends in Agricultural Land & Lease Values"*. American Society of Farm Managers and Rural Appraisers, Woodbridge, CA. calasfmra.com

California Department of Insurance. 2020 California Workers' Compensation Rating Data for Selected Agricultural Classifications as of January 2020. California Department of Insurance, Rate Regulation Branch. insurance.ca.gov/0500-about-us/

Energy Information Administration. Weekly Retail on Highway Diesel Prices. eia.gov/petroleum/gasdiesel/

University of California Statewide Integrated Pest Management Program. *UC Pest Management Guidelines, Avocados*. 2019. University of California, Davis, CA. ipm.ucanr.edu/.

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 1. COSTS PER ACRE TO ESTABLISH AN AVOCADO ORCHARD

San Diego County-2020

	Years (total costs/acre)						Your
	Estab/1st	**2nd**	**3rd**	**4th**	**5th**	**6th**	**Costs**
Pre-Plant:							
Preparation - Crushing (Brush)	2,512						
Preparation - Digging	65						
Orchard Layout (grading/drainage/erosion)	2,600						
TOTAL PRE-PLANT COSTS	5,177						
Plant:							
Avocado Trees (430) & Labor	15,833						
Stakes	946						
Gypsum & Labor	36						
Mulch & Labor	200						
TOTAL PLANT COSTS	17,015						
Re-Plant:							
Replacement Trees & Labor	368						
TOTAL RE-PLANT COSTS	368						
Cultural:							
Mulch & Labor			200				
Erosion Control (grading/seeding) 2x	258	258	258	258	258	258	
Weed Control - Glyphosate	90	90	90	90	90	90	
Weed Control - Weed Whipping	77	58	58	58	58	39	
Rodent Control - Gophers	44	44	44	44	44	44	
Rodent Control - Squirrels	38	38	38	38	38	38	
Fertilizer - CAN17%	34	69	103	138	172	207	
Fertilizer - Zinc Sulfate 12%					5	5	
Fertilizer - 15-5-5	35	35	35	35	35	35	
Root Rot Treatment	66	66	66	66	66	66	
Irrigation & Walk Lines	2,474	6,521	5,723	9,408	7,451	7,451	
Pest Control Advisor			38	38	38	38	
Insects: Abamectin/Oil			170	170	170	170	
Orchard Pruning			162	518	835	936	
Fertilizer - 21-7-4	116	116	116	116	116	116	
Pickup Truck Use	53	53	69	69	69	69	
ATV Use	76	76	76	76	76	76	
Clearing Isles - Labor				308	308	308	
Road Repairs		38		38	38	38	
TOTAL CULTURAL COSTS	3,361	7,462	7,246	11,468	9,867	9,984	
Harvesting and Marketing:							
Picking $0.09			1,192	2,259	499	1,889	
Hauling 0.004			53	100	22	84	
CAC Assessment Fee 0.01			174	326	64	372	
TOTAL HARVESTING & MARKETING COSTS			1,419	2,685	585	2,345	
Interest on Operating Capital at 5.25%	1,587	175	100	166	129	161	
TOTAL OPERATING COSTS/ACRE	27,508	7,637	8,765	14,319	10,581	12,490	

UC COOPERATIVE EXTENSION AND UC AGRICULTURAL ISSUES CENTER

TABLE 1. CONTINUED

San Diego County-2020

Operation	Yr. 1	Yr.2	Yr.3	Yr. 4	Yr. 5	Yr. 6	Your Costs
CASH OVERHEAD:							
Office Expense	150	150	150	150	150	150	
Liability Insurance	26	26	26	26	26	26	
Leaf Analysis	8	8	8	8	8	8	
Soil Analysis	9	9	9	9	9	9	
Property Taxes	271	271	271	413	413	413	
Property Insurance	24	24	24	37	37	37	
Investment Repairs	74	74	74	74	74	74	
TOTAL CASH OVERHEAD COSTS/ACRE	562	562	562	717	717	717	
TOTAL CASH COSTS/ACRE	28,070	8,199	9,327	15,036	11,298	13,207	
INCOME/ACRE FROM PRODUCTION			**17,187**	**29,191**	**9,810**	**27,069**	
NET CASH COSTS/ACRE FOR THE YEAR	28,070	8,199			1,488		
PROFIT/ACRE ABOVE CASH COSTS			**7,860**	**14,155**		**13,862**	
ACCUMULATED NET CASH COSTS/ACRE	28,070	36,269	**28,409**	14,254	15,742	1,880	
NON-CASH OVERHEAD: (Capital Recovery)							
Building (1,800 SqFt)	30	30	30	30	30	30	
Irrigation System	167	167	167	167	167	167	
Fuel Tanks	21	21	21	21	21	21	
Tools	26	26	26	26	26	26	
Land	1,386	1,386	1,386	1,386	1,386	1,386	
Establishment Costs				1,955	1,955	1,955	
Equipment	12	12	12	12	12	12	
TOTAL NON-CASH OVERHEAD COSTS	1,642	1,642	1,642	3,597	3,597	3,597	
TOTAL COST/ACRE FOR THE YEAR	29,712	9,841	10,969	18,633	14,895	16,804	
INCOME/ACRE FROM PRODUCTION			**17,187**	**29,191**	**9,810**	**27,069**	
TOTAL NET COST/ACRE FOR THE YEAR	29,712	9,841			5,085		
PROFIT/ACRE ABOVE TOTAL COST			**6,218**	**10,558**		**10,265**	
TOTAL ACCUMULATED NET COST/ACRE	29,712	39,553	33,335	22,777	27,862	17,597	

UC COOPERATIVE EXTENSION AND UC AGRICULTURAL ISSUES CENTER

TABLE 2. MATERIAL AND CUSTOM COSTS-ESTABLISHMENT YEARS

San Diego County-2020

			Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		
								Total Per Acre							
OPERATING COSTS	Unit	$/Unit	Unit	$	Unit	$	Unit	$	Unit	$	Unit	$	Unit	$	Your Costs
Water:				**2,223**		**6,270**		**5,472**		**9,158**		**7,201**		**7,201**	
San Diego District Water	AcIn	158.33	14.04	2,223	39.60	6,270	34.56	5,472	57.84	9,158	45.48	7,201	45.48	7,201	
Fertilizers:				**222**		**220**		**254**		**289**		**328**		**363**	
Gypsum	Lbs.	0.01	3,010	36		-		-		-		-		-	
CAN-17%	Gal	1.00	34.49	34	68.98	69	103.47	103	137.97	138	172.46	172	206.95	207	
15-5-5	Quart	1.45	24.00	35	24.00	35	24.00	35	24.00	35	24.00	35	24.00	35	
Zinc Sulfate 12%	Gal	4.60									1.00	5	1.00	5	
21-7-14	Lbs.	0.83	140.00	116	140.00	116	140.00	116	140.00	116	140.00	116	140.00	116	
Herbicide:				**3**		**3**		**3**		**3**		**3**		**3**	
Generic Glyphosate	Oz	0.11	30.00	3	30.00	3	30.00	3	30.00	3	30.00	3	30.00	3	
Rodenticide:				**14**		**14**		**14**		**14**		**14**		**14**	
Gopher Trap	Acre	5.00	1.00	5	1.00	5	1.00	5	1.00	5	1.00	5	1.00	5	
Squirrel Bait Station	Acre	0.23	1.00	0	1.00	0	1.00	0	1.00	0	1.00	0	1.00	0	
Squirrel Bait	Lbs.	3.00	2.64	8	2.64	8	2.64	8	2.64	8	2.64	8	2.64	8	
Squirrel Trap	Acre	1.00	1.00	1	1.00	1	1.00	1	1.00	1	1.00	1	1.00	1	
Planting:				**15,226**		**-**		**200**		**-**		**-**		**-**	
Avocado Trees	Tree	32.00	440.00	14,080		-		-		-		-		-	
Stakes	Each	2.20	430.00	946		-		-		-		-		-	
Mulch	Cu-Yard	5.00	40.00	200		-	40.00	200		-		-		-	
Custom:				**2,852**		**238**		**383**		**421**		**421**		**421**	
Pickup: 4 Door/4WD 3/4-Ton	Acre	44.00	1.00	44		-		-		-		-		-	
Drilling/Auger: Rental	Day	25.00	0.30	8		-		-		-		-		-	
Orchard Layout	Acre	2,600	1.00	2,600		-		-		-		-		-	
Float/Grading	Acre	75.00	1.00	75	1.00	75	1.00	75	1.00	75	1.00	75	1.00	75	
Seeding (erosion control)	Acre	35.00	1.00	35	1.00	35	1.00	35	1.00	35	1.00	35	1.00	35	
Seed Mix (erosion control)	Lbs.	9.00	10.00	90	10.00	90	10.00	90	10.00	90	10.00	90	10.00	90	
Pest Control Advisor	Acre	38.00					1.00	38	1.00	38	1.00	38	1.00	38	
Helicopter Rental	Acre	145.00					1.00	145	1.00	145	1.00	145	1.00	145	
Road Repair	Acre	38.00			1.00	38	-	-	1.00	38	1.00	38	1.00	38	

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

Table 2. CONTINUED

San Diego County-2020

			Year 1		Year 2		Year 3		Year 4		Year 5		Year 6	
							Total Per Acre							
OPERATING COSTS	Unit	$/Unit	Unit	$	Unit	$	Unit	$	Unit	$	Unit	$	Unit	$	Your Costs
Disease: Root Rot:				**66**		**66**		**66**		**66**		**66**		**66**	
Potassium Phosphite (Fungicide)	Gal	33.00	2.00	66	2.00	66	2.00	66	2.00	66	2.00	66	2.00	66	
Insecticide:								**25**		**25**		**25**		**25**	
Abamectin	Oz	1.00					15.00	15	15.00	15	15.00	15	15.00	15	
NR-415 Oil	Gal	10.00					1.00	10	1.00	10	1.00	10	1.00	10	
Harvest:								**1,419**		**2,685**		**585**		**2,344**	
Picking - Labor	Lbs./Ac	0.09					13,246	1,192	25,100	2,259	5,541	499	20,992	1,889	
Hauling	Lbs./Ac	0.004					13,246	53	25,100	100	5,541	22	20,992	84	
CAC Assessment Fee (P-value)	$/Ac	0.010					17,430	174	32,565	326	6,446	64	37,116	371	
Labor:				**5,304**		**1,241**		**800**		**1,465**		**1,782**		**1,863**	
Equipment Operator	Hrs.	26.70	4.40	117	27.00	721	4.40	117	4.40	117	4.40	117	4.40	117	
Manual	Hrs.	19.28	256.00	4,936	14.00	270	14.00	270	30.00	578	30.00	578	29.00	559	
Pruning	Hrs.	19.28					8.42	162	26.89	518	43.33	835	48.56	936	
Irrigation	Hrs.	19.28	13.00	251	13.00	251	13.00	251	13.00	251	13.00	251	13.00	251	
Machinery:				**17**		**27**		**27**		**27**		**27**		**27**	
Fuel-Gas	Gal	3.20	3.00	10	5.78	18	5.78	18	5.78	18	5.78	18	5.78	18	
Fuel-Diesel	Gal	2.92	-	-		-		-		-		-		-	
Lube				1		3		3		3		3		3	
Machinery Repair				6		6		6		6		6		6	
Interest on Operating Capital @ 5.25%				1,587		100		100		166		129		161	
TOTAL OPERATING COSTS/ACRE				27,513		8,180		8,765		14,320		10,582		12,489	

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 3. COSTS PER ACRE TO PRODUCE AVOCADOS

San Diego County - 2020

Operation	Equipment Time (Hrs./Ac)	Labor Cost	Fuel	Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
			Cash and Labor Costs per Acre					
Cultural:								
Erosion Control	0.00	58	0	0	0	200	258	
Weed Control - Glyphosate	0.00	87	0	0	3	0	90	
Weed Control - Weed Whipping	0.00	39	0	0	0	0	39	
Rodent Control - Gophers	0.00	39	0	0	5	0	44	
Rodent Control - Squirrels	0.00	29	0	0	9	0	38	
Fertilizer - CAN17%	0.00	0	0	0	241	0	241	
Fertilizer - 15-5-5	0.00	0	0	0	35	0	35	
Fertilizer - Zinc Sulfate 12%	0.00	0	0	0	5	0	5	
Disease - Root Rot	0.00	0	0	0	66	0	66	
Irrigation & Walk Lines	0.00	251	0	0	7,201	0	7,451	
Fertilizer - 21-7-14	0.00	0	0	0	116	0	116	
Pest Control Advisor	0.00	0	0	0	0	38	38	
Insects - Abamectin/NR-415 Oil	0.00	0	0	0	25	145	170	
Prune - Labor	0.00	936	0	0	0	0	936	
Road Repairs	0.00	0	0	0	0	38	38	
Clearing Isles - Labor	0.00	308	0	0	0	0	308	
Pickup Truck	1.67	53	9	7	0	0	69	
ATV	2.00	64	10	2	0	0	76	
TOTAL CULTURAL COSTS	3.67	1,863	18	9	7,706	421	10,018	
Harvesting and Marketing Costs:								
Picking	0.00	0	0	0	1,460	0	1,460	
Hauling	0.00	0	0	0	65	0	65	
CAC Assessment Fee	0.00	0	0	0	225	0	225	
TOTAL HARVESTING AND MARKETING	0.00	0	0	0	1,750	0	1,750	
Interest on Operating Capital at 5.25%							152	
TOTAL OPERATING COSTS/ACRE	3.67	1,863	18	9	9,456	421	11,920	
CASH OVERHEAD:								
Office Expense							150	
Liability Insurance							26	
Leaf Analysis							8	
Soil Analysis							9	
Property Taxes							413	
Property Insurance							37	
Investment Repairs							74	
TOTAL CASH OVERHEAD COSTS/ACRE							716	
TOTAL CASH COSTS/ACRE							12,637	
NON-CASH OVERHEAD:		Per Producing Acre		Annual Cost Capital Recovery				
Building (1,800 SqFt)		476		30			30	
Irrigation System		2,600		167			167	
Fuel Tanks (2; 400Gal)		258		21			21	
Tools		381		26			26	
Land		25,200		1,386			1,386	
Establishment Costs		28,409		1,955			1,955	
Equipment		61		12			12	
TOTAL NON-CASH OVERHEAD COSTS		57,385		3,569			3,596	
TOTAL COSTS/ACRE							16,233	

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 4. COSTS AND RETURNS PER ACRE TO PRODUCE AVOCADOS

San Diego County - 2020

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Avocado	16,220	Lbs.	1.39	22,494	
TOTAL GROSS RETURNS				22,494	
OPERATING COSTS					
Water:				**7,201**	
San Diego District Water	45.48	AcIn	158.33	7,201	
Fertilizers:				**397**	
CAN-17%	241.44	Gal	1.00	241	
15-5-5	24.00	Quart	1.45	35	
Zinc Sulfate 12%	1.00	Gal	4.60	5	
21-7-14	140.00	Lbs.	0.83	116	
Insecticide:				**25**	
Abamectin	15.00	Oz	1.00	15	
NR-415 Oil	1.00	Gal	10.00	10	
Harvest:				**1,750**	
Picking – Labor	16,220.00	Lbs.	0.09	1,460	
Hauling	16,220.00	Lbs.	0.004	65	
CAC Assessment Fee	22,494.00	P-Value	0.01	225	
Herbicide:				**3**	
Generic Glyphosate	30.00	Oz	0.11	3	
Rodenticide:				**14**	
Gopher Trap	1.00	Acre	5.00	5	
Squirrel Bait Station	1.00	Acre	0.23	0	
Squirrel Bait	2.64	Lbs.	3.00	8	
Squirrel Trap	1.00	Acre	1.00	1	
Custom:				**421**	
Float/Grading	1.00	Acre	75.00	75	
Seeding (erosion control)	1.00	Acre	35.00	35	
Seed Mix (erosion control)	10.00	Lbs.	9.00	90	
Pest Control Advisor	1.00	Acre	38.00	38	
Helicopter Rental	1.00	Acre	145.00	145	
Road Repair	1.00	Acre	38.00	38	
Disease: Root Rot:				**66**	
Potassium Phosphite (Fungicide)	2.00	Gal	33.00	66	
Labor:				**1,863**	
Equipment Operator Labor	4.40	Hrs.	26.70	117	
Manual Labor	29.00	Hrs.	19.28	559	
Irrigation Labor	13.00	Hrs.	19.28	251	
Pruning Labor	48.56	Hrs.	19.28	936	
Machinery:				**27**	
Fuel-Gas	5.78	Gal	3.20	18	
Fuel-Diesel	0.00	Gal	2.92	0	
Lube				3	
Machinery Repair				6	
Interest on Operating Capital @ 5.25%				152	
TOTAL OPERATING COSTS/ACRE				11,920	
TOTAL OPERATING COSTS/LBS				0.73	
NET RETURNS ABOVE OPERATING COSTS				10,573	

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 4. CONTINUED

San Diego County – 2020

CASH OVERHEAD COSTS	
Office Expense	150
Liability Insurance	26
Leaf Analysis	8
Soil Analysis	9
Property Taxes	413
Property Insurance	37
Investment Repairs	74
TOTAL CASH OVERHEAD COSTS/ACRE	716
TOTAL CASH OVERHEAD COSTS/LBS	0.04
TOTAL CASH COSTS/ACRE	12,637
TOTAL CASH COSTS/LBS	0.78
NET RETURNS ABOVE CASH COSTS	9,857
NON-CASH OVERHEAD COSTS (Capital Recovery)	
Building (1,800 SqFt)	30
Irrigation System	167
Fuel Tanks (2; 400Gal)	21
Tools	26
Land	1,386
Establishment Costs	1,955
Equipment	12
TOTAL NON-CASH OVERHEAD COSTS/ACRE	3,596
TOTAL NON-CASH OVERHEAD COSTS/LBS	0.22
TOTAL COST/ACRE	16,233
TOTAL COST/LBS	1.00
NET RETURNS ABOVE TOTAL COST	6,260

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 5. MONTHLY CASH COSTS PER ACRE TO PRODUCE AVOCADOS

San Diego County - 2020

	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	Total
Cultural:												
Erosion Control	129	129										258
Weed Control - Glyphosate			30			30			30			90
Weed Control - Weed Whipping				39								39
Rodent Control - Gophers	4	4	4	4	4	4	4	4	4	4	4	44
Rodent Control - Squirrels	3	3	3	3	3	3	3	3	3	3	3	38
Fertilizer - CAN17%			27	27	27	27	27	27	27	27	27	241
Fertilizer - 15-5-5				12		12				12		35
Fertilizer - Zinc Sulfate 12%						2				2		5
Disease - Root Rot						33				33		66
Irrigation & Walk Lines				732	716	732	1,275	1,266	1,275	751	705	7,451
Fertilizer - 21-7-14											116	116
Pest Control Advisor				38								38
Insects - Abamectin/NR-415 Oil					170							170
Prune - Labor				936								936
Road Repairs				38								38
Clearing Isles - Labor								154		154		308
Pickup Truck	6	6	6	6	6	6	6	6	6	6	6	69
ATV	7	7	7	7	7	7	7	7	7	7	7	76
TOTAL CULTURAL COSTS	150	150	77	1,842	933	856	1,323	1,467	1,353	1,000	868	10,018
Harvesting and Marketing Costs:												
Picking		182	182	182	182	182	182	182	182			1,460
Hauling		8	8	8	8	8	8	8	8			65
CAC Assessment Fee									225			225
TOTAL HARVESTING AND MARKETING	0	191	191	191	191	191	191	191	416	0	0	1,750
Interest on Operating Capital @5.25%	0.65	2.14	3.31	12.21	17.12	21.70	28.32	35.58	43.31	-8.17	-3.80	152.38
TOTAL OPERATING COSTS/ACRE	150	342	271	2,044	1,141	1,068	1,542	1,693	1,812	991	865	11,920
CASH OVERHEAD												
Office Expense										150		150
Liability Insurance										26		26
Leaf Analysis										9		9
Soil Analysis										10		10
Property Taxes			207					207				413
Property Insurance			18					18				37
Investment Repairs	7	7	7	7	7	7	7	7	7	7	7	74
TOTAL CASH OVERHEAD COSTS	7	7	232	7	7	7	7	232	7	199	7	716
TOTAL CASH COSTS/ACRE	157	349	503	2,051	1,148	1,075	1,548	1,925	1,818	1,190	871	12,637

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 6. RANGING ANALYSIS

San Diego County - 2020

COSTS PER ACRE AND PER LBS AT VARYING YIELDS TO PRODUCE AVOCADOS

	YIELD (LBS/AC)						
	11,719.75	13,219.75	14,719.75	16,219.75	17,719.75	19,219.75	20,719.75
OPERATING COSTS/ACRE:							
Cultural	10,018	10,018	10,018	10,018	10,018	10,018	10,018
Harvesting and Marketing	1,282	1,438	1,594	1,750	1,905	2,061	2,217
Interest on Operating Capital @ 5.25%	144	147	150	152	155	158	161
TOTAL OPERATING COSTS/ACRE	11,445	11,603	11,762	11,920	12,079	12,237	12,396
TOTAL OPERATING COSTS/LBS	0.98	0.88	0.80	0.73	0.68	0.64	0.60
CASH OVERHEAD COSTS/ACRE	716	716	716	716	716	716	716
TOTAL CASH COSTS/ACRE	12,161	12,320	12,478	12,637	12,795	12,954	13,112
TOTAL CASH COSTS/LBS	1.04	0.93	0.85	0.78	0.72	0.67	0.63
NON-CASH OVERHEAD COSTS/ACRE	3,596	3,596	3,596	3,596	3,596	3,596	3,596
TOTAL COSTS/ACRE	15,757	15,916	16,075	16,233	16,392	16,550	16,709
TOTAL COSTS/LBS	1.34	1.20	1.09	1.00	0.93	0.86	0.81

Net Return per Acre Above Operating Costs for Avocados

PRICE ($/lbs.)	YIELD (lbs./acre)						
Avocado	11719.75	13219.75	14719.75	16219.75	17719.75	19219.75	20719.75
0.64	-3,982	-3,185	-2,388	-1,592	-795	2	798
0.89	-1,052	120	1,292	2,463	3,635	4,807	5,978
1.14	1,878	3,425	4,972	6,518	8,065	9,612	11,158
1.39	4,808	6,730	8,652	10,573	12,495	14,417	16,338
1.64	7,738	10,035	12,332	14,628	16,925	19,221	21,518
1.89	10,668	13,340	16,011	18,683	21,355	24,026	26,698
2.14	13,598	16,645	19,691	22,738	25,785	28,831	31,878

Net Return per Acre Above Cash Costs for Avocados

PRICE ($/lbs.)	YIELD (lbs./acre)						
Avocado	11719.75	13219.75	14719.75	16219.75	17719.75	19219.75	20719.75
0.64	-4,698	-3,901	-3,105	-2,308	-1,511	-715	82
0.89	-1,768	-596	575	1,747	2,919	4,090	5,262
1.14	1,162	2,709	4,255	5,802	7,349	8,895	10,442
1.39	4,092	6,014	7,935	9,857	11,778	13,700	15,622
1.64	7,022	9,318	11,615	13,912	16,208	18,505	20,802
1.89	9,952	12,623	15,295	17,967	20,638	23,310	25,982
2.14	12,882	15,928	18,975	22,022	25,068	28,115	31,162

Net Return per Acre Above Total Costs for Avocados

PRICE ($/lbs.)	YIELD (lbs./acre)						
Avocado	11719.75	13219.75	14719.75	16219.75	17719.75	19219.75	20719.75
0.64	-8,294	-7,498	-6,701	-5,904	-5,108	-4,311	-3,514
0.89	-5,364	-4,193	-3,021	-1,849	-678	494	1,665
1.14	-2,434	-888	659	2,205	3,752	5,299	6,845
1.39	495	2,417	4,339	6,260	8,182	10,104	12,025
1.64	3,425	5,722	8,019	10,315	12,612	14,909	17,205
1.89	6,355	9,027	11,699	14,370	17,042	19,714	22,385
2.14	9,285	12,332	15,379	18,425	21,472	24,519	27,565

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 7. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT, AND BUSINESS OVERHEAD

San Diego County - 2020

ANNUAL EQUIPMENT COSTS

Description	Price	Yrs. Life	Salvage Value	Capital Recovery	Cash Overhead Insurance	Cash Overhead Taxes	Total
Truck: pickup	35,000	3	18,533	7,123	24	268	7,414
ATV	8,500	6	3,505	1,193	5	60	1,258
TOTAL	43,500	-	22,038	8,316	29	328	8,672
60% of New Cost*	26,100	-	13,223	4,989	17	197	5,203

ANNUAL INVESTMENT COSTS

Description	Price	Yrs. Life	Salvage Value	Capital Recovery	Cash Overhead Insurance	Cash Overhead Taxes	Cash Overhead Repairs	Total
INVESTMENT								
Building (1,800 SqFt)	10,000	40	0	623	4	50	200	878
Irrigation System	52,000	36	0	3,347	23	260	1,040	4,670
Fuel Tanks (2; 400Gal)	5,418	20	380	442	3	29	108	582
Tools	8,000	30	800	539	4	44	160	747
Land	504,000	36	504,000	27,720	447	5,040	0	33,207
Establishment Costs	568,180	30	0	39,094	252	2,841	0	42,186
TOTAL INVESTMENT	1,147,598	-	505,180	71,766	732	8,264	1,508	82,270

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Office Expense	21	Acre	150.00	3,150
Liability Insurance	21	Acre	26.00	546
Leaf Analysis	20	Acre	7.50	150
Soil Analysis	20	Acre	8.66	173

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

TABLE 8. HOURLY EQUIPMENT COSTS

San Diego County - 2020

Description	Avocado Hours Used	Capital Recovery	Cash Overhead Insurance	Cash Overhead Taxes	Operating Lube & Repairs	Operating Fuel	Operating Total Oper.	Total Costs/Hr.
Pickup Truck	33	6.42	0.02	0.24	4.28	5.33	9.61	16.29
ATV	40	0.61	0.00	0.03	0.94	4.80	5.74	6.38

UC COOPERATIVE EXTENSION AND AGRICULTURAL ISSUES CENTER

Table 9. OPERATIONS WITH EQUIPMENT AND MATERIALS

San Diego County - 2020

Operation	Month	Tractor	Implement	Material	acre	Unit
Erosion Control	Dec			Manual Labor	1.50	hours
				Float/Grading	0.50	Acre
				Seeding (erosion control)	0.50	Acre
				Seed Mix (erosion control)	5.00	Lbs.
	Jan			Manual Labor	1.50	hours
				Float/Grading	0.50	Acre
				Seeding (erosion control)	0.50	Acre
				Seed Mix (erosion control)	5.00	Lbs.
Weed Control	Feb			Manual Labor	1.50	hours
				Generic Glyphosate	10.00	Oz
	May			Manual Labor	1.50	hours
				Generic Glyphosate	10.00	Oz
	Aug			Manual Labor	1.50	hours
				Generic Glyphosate	10.00	Oz
Weed Control	Mar			Manual Labor	2.00	hours
Rodent Control	Mar			Manual Labor	2.00	hours
				Gopher Trap	1.00	Acre
Rodent Control	Mar			Manual Labor	1.50	hours
				Squirrel Bait Station	1.00	Acre
				Squirrel Bait	2.64	Lbs.
				Squirrel Trap	1.00	Acre
Fertilizer - CAN17%	Feb			CAN-17%	26.83	Gal
	Mar			CAN-17%	26.83	Gal
	Apr			CAN-17%	26.83	Gal
	May			CAN-17%	26.83	Gal
	June			CAN-17%	26.83	Gal
	July			CAN-17%	26.83	Gal
	Aug			CAN-17%	26.83	Gal
	Sept			CAN-17%	26.83	Gal
	Oct			CAN-17%	26.80	Gal
Fertilizer - 15-5-5	Mar			15-5-5	8.00	Quart
	May			15-5-5	8.00	Quart
	Sept			15-5-5	8.00	Quart
Fertilizer - Zinc	May			Zinc Sulfate 12%	0.50	Gal
	Sept			Zinc Sulfate 12%	0.50	Gal
Disease - Root Rot	May			Potassium Phosphite (Fungicide)	1.00	Gal
	Sept			Potassium Phosphite (Fungicide)	1.00	Gal
Irrigation-Walk Lines	Mar			Irrigation Labor	1.00	hour
				San Diego District Water	4.50	AcIn
	Apr			Irrigation Labor	1.00	hour
				San Diego District Water	4.40	AcIn
	May			Irrigation Labor	1.00	hour
				San Diego District Water	4.50	AcIn
	June			Irrigation Labor	2.50	hours
				San Diego District Water	7.75	AcIn
	July			Irrigation Labor	2.00	hours
				San Diego District Water	7.75	AcIn
	Aug			Irrigation Labor	2.50	hours
				San Diego District Water	7.75	AcIn
	Sept			Irrigation Labor	2.00	hours
				San Diego District Water	4.50	AcIn
	Oct			Irrigation Labor	1.00	hour
				San Diego District Water	4.33	AcIn
Fertilizer - 21-7-14	Oct			21-7-14	140.00	Lbs.
Pest Control Advisor	Mar			Pest Control Advisor	1.00	Acre
Insects	Apr			Abamectin	15.00	Oz
				NR-415 Oil	1.00	Gal
				Helicopter Rental	1.00	Acre
Prune	Mar			Pruning Labor	48.56	hours
Road Repairs	Mar			Road Repair	1.00	Acre
Clearing Isles	July			Manual Labor	8.00	hours
	Sep			Manual Labor	8.00	hours
Pickup Truck	Sept		Truck: pickup	Equipment Operator Labor	2.00	hours
ATV	Sept		ATV	Equipment Operator Labor	2.40	hours
Harvest - Picking	Jan – Aug			Picking-Labor	16,219.75	Lbs.
Harvest - Hauling	Jan - Aug			Hauling-Labor	16,219.75	Lbs.